Space Weather Technical Forecast

Issued on Friday, 21 April 2023 at 01:23 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/Minor Storms likely due to CME activity, with a slight chance of G2/Moderate or G3/Strong Storms. Chance of M-class flares (R1-R2 Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with the background solar activity predominantly at C-class level, and the largest event of the period was a C3 at 20/0922Z from AR3281. There are currently six regions on the visible disc, five of which are numbered. AR3282 remains the largest and most complex region on the disc, located in the northwest quadrant, and is now classified as Fki/Beta-Gamma. AR3283 has shown some slight increase in complexity, and is currently classified as Dao/Beta, with the potential to develop further. The remaining groups are mostly small and simple, and appear to be either stable or in slow decay, including a new region which has recently rotated onto the visible disc.

No Earth-directed CMEs have been observed in available imagery during the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind as observed by DSCOVR at L1, showed residual weak CME effects. Wind speeds were initially slightly elevated, around 420 km/s, then gradually declined to end the period at background levels, around 370 km/s. Density was average until the evening, then fell to below average levels. Total magnetic field strength was at moderate levels for much of the day, 10-11 nT, then declined through the evening to become weak. The north-south component was positive throughout, moderate becoming weak later in the day. The phi angle remained negative (away from the Sun). Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, was at background levels. High energy electron flux (greater than 2MeV) as measured at GOES16 was predominantly at background levels. The associated 24-hour integrated electron fluence was well below the Active threshold on a steady trend, with 1.38e6 integrated pfu observed at 21/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be generally Low, with a chance of isolated Moderate activity, mainly due to AR3282 but also potentially from AR3281.

Solar Wind / Geomagnetic Activity: A CME may arrive at Earth today (21st Apr), possibly even tomorrow (22nd Apr). Confidence is low in the timing and impact of this feature. Otherwise, a coronal hole high speed streams may produce elevated wind speeds from late tomorrow (22 Apr), but more likely from day 3 (23rd).

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Met Office Space Weather Technical Forecast

Geomagnetic activity is forecast to be Quiet (Kp 1-2) until the expected CME arrives. Geomagnetic activity is expected to then increase, becoming Unsettled to Active (Kp 3-4) with G1/Minor Storms (Kp 5) intervals likely, and a slight chance of G2-G3 Moderate-Strong Storm (Kp 6-7) intervals. Effects will slowly decline through the following days.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is most likely to persist at background levels, although there is a slight chance of S1 or greater, mainly due to AR3281 or AR3282. High energy (greater than 2 MeV) electron flux is currently at background levels with little change expected throughout much of the period, although through day 4 (24th) an increase to moderate to occasionally high levels is likely in response to HSS effects. The associated 24-hour integrated fluence is expected to remain below the Active threshold (1e8 integrated pfu), but with an increasing trend later in the period.

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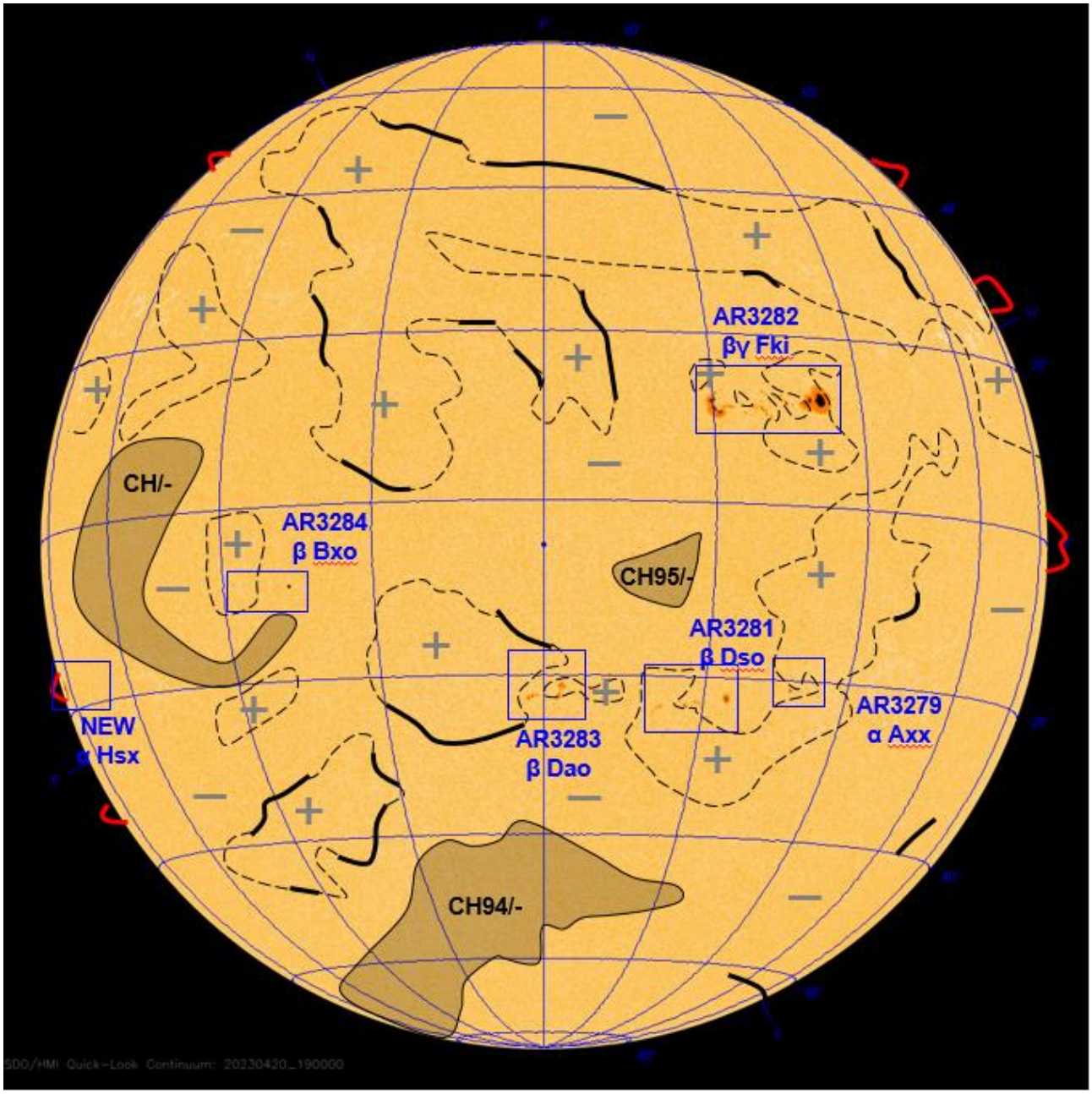
Figure 1. Solar Analysis Valid 20/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A faint CME halo from a large filament eruption late on 15 April is likely to affect Earth, arriving sometime today, or even possibly tomorrow. Confidence in the arrival time and geomagnetic effects is low given the apparent diffuse signature of the CME in LASCO C2 and C3 imagery and limited STEREO A data for the event. The expected arrival could occur anytime within the next 24 hours.

Solar winds are currently at background levels The next high speed stream from CH94 or CH95 (both negative) are not expected to become geoeffective until Days 2 or 3 (22-23 Apr). CH94 is a high latitude feature so may not reach Earth. CH95 was more centrally located but was small and is no longer visible. Therefore, wind speeds may only reach 450-550 km/s.
Geomagnetic activity is forecast to be Quiet (Kp 1-2) until the expected CME arrives.
Geomagnetic activity is expected to then increase, becoming Unsettled to Active (Kp 3-4) with G1/Minor Storms (Kp 5) intervals likely, and a slight chance of G2-G3 Moderate-Strong Storm (Kp 6-7) intervals. Effects will slowly decline through the following days.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	50	30	10
Strong	G3	No	10	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/1343	Full	Filament eruption	NW	342 km/s	20/1300 UTC +/- 12 hours	Low confidence in arrival time and impact.

Figure 2: MOSWOC Enlil ensemble showing the range of arrival times for the predicted CME.

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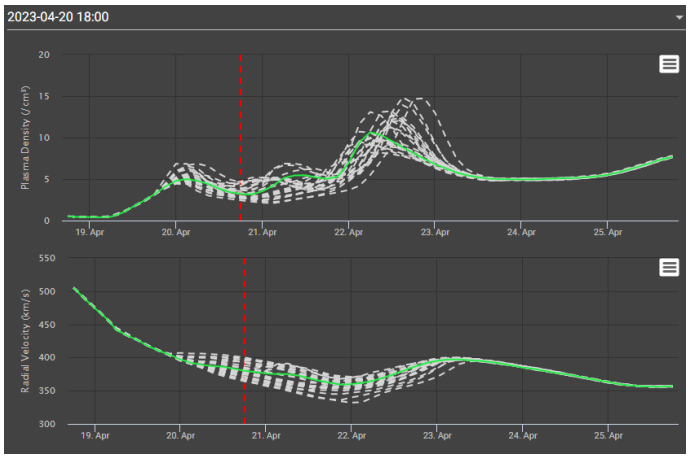


Figure 3: SDO AIA 211 images, from previous rotation (left) and recently (right). CH95 is not visible and CH94 in the south is smaller and further east compared to the previous rotation.

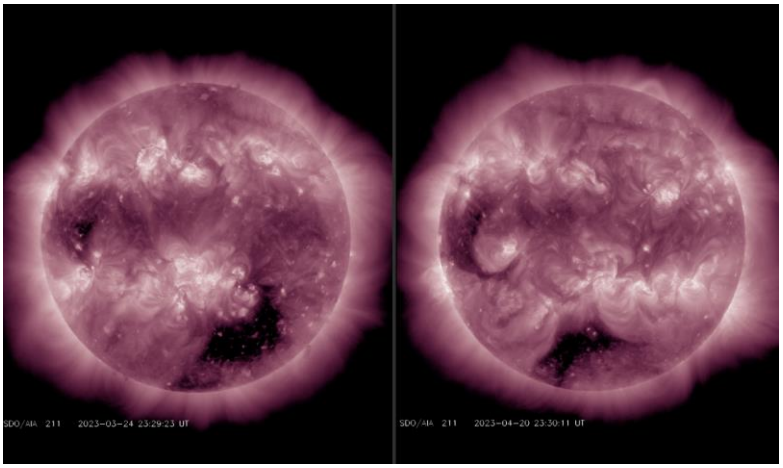
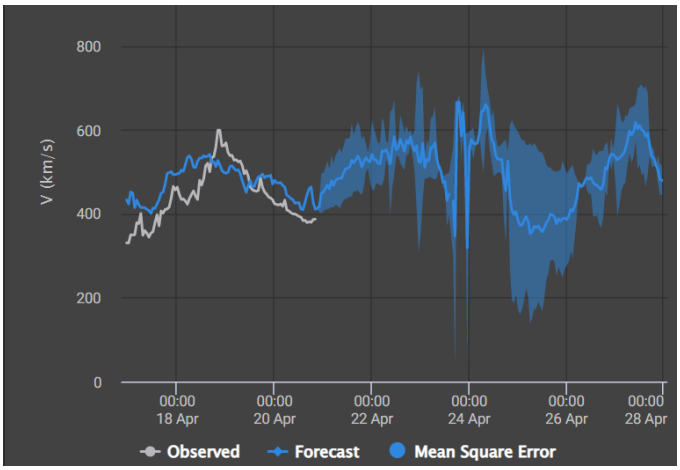


Figure 4: Solar wind persistence, with the increase in the solar wind due to HSS effects not expected as quickly, due to the current size and location of CH94.



Radio Blackouts - X-Ray Flares:

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There are currently five numbered regions on the visible disc. AR3282 remains the largest and most complex, located in the northwest quadrant. An intermediate spot, and associated penumbra, has merged with the leading spot resulting in the changed classification to Fki, while the Beta-Gamma configuration persists. The remaining intermediate portion will continue to be monitored for any potential 'delta' spot emerging, but this is currently looking less likely due to the fading of the penumbra around some of the intermediate spots. AR3283 remains classified as Dao/Beta configuration, with a slight growth in the rudimentary penumbra of the intermediate spot. AR3284 appears to be decaying, with the trailing spot fading and currently barely visible. The remaining regions appear small, weak and stable, including the new region which has rotated onto the southeast limb. However, there is potential for this new region to be re-classified as it becomes easier to analyse, as it transits across the visible disc. Another new region may also emerge from the far side during the forecast period.

Solar activity is likely to remain Low, despite the classification of AR3282. However, there is a chance of becoming Moderate with isolated M-flares. Any significant flares are most likely to originate from AR3282, but also from AR3281 which produced the largest flare of the past 24 hours.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES16, is currently at background levels. There is a slight chance of an increase to S1 or greater, should any larger flares occur, mainly from AR3281 or AR3282. The risk increases slightly as these regions moves further into the western hemisphere.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

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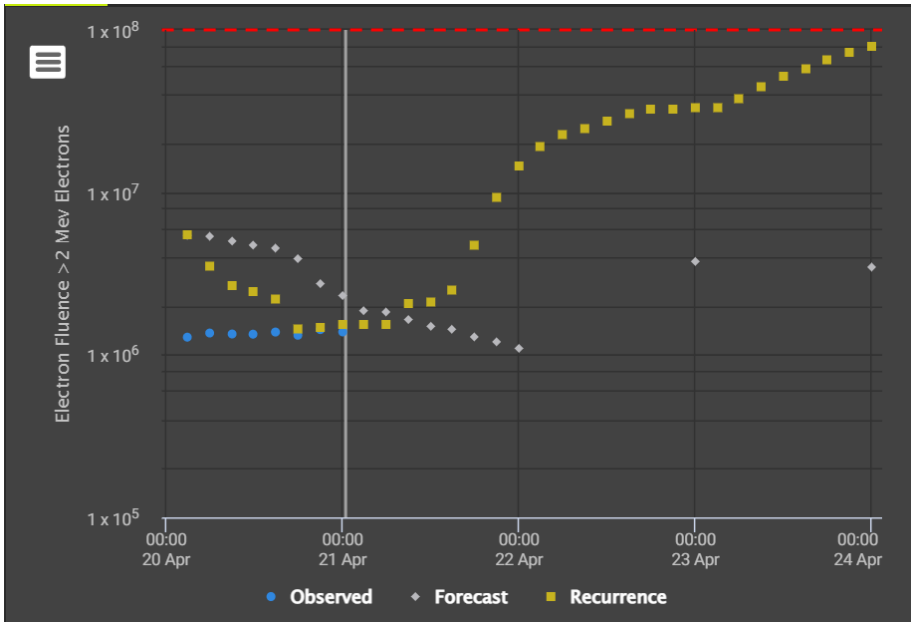
High energy (greater than 2 MeV) electron flux is currently at background levels with little change expected throughout much of the period, although through day 4 (24th) an increase to moderate to occasionally high levels is likely in response to HSS effects. The associated 24-hour integrated fluence is expected to remain below the Active threshold (1e8 integrated pfu), but with an increasing trend later in the period.

The associated 24-hour integrated fluence is expected to remain below the Active threshold (1e8 integrated pfu), but with an increasing trend later in the period. MOSWOC REFM is forecasting a decreasing trend through today, with an increasing trend thereafter, while keeping the fluence below the Active threshold. This is accepted as offering good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: Met Office REFM model.



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